Remarks

Reconsideration of the subject application is requested in view of the following remarks.

Claims 1-31 are pending. In this paper, no claims are amended.

The search performed by the examiner in connection with performing a substantive examination of the claims is appreciated.

Claims 1-5, 9-12, 15, and 26-31 stand rejected for alleged obviousness from Pencis. This rejection is traversed.

Exemplary of the subject claims, independent claim 1 is directed specifically to charged-particle-beam (CPB) microlithography systems, not to the entire universe of wafer-processing systems. Pencis is absolutely silent regarding CPB microlithography systems and silent regarding any other systems that use or include a charged particle beam. Pencis also provides no teaching, suggestion, or hint whatsoever that would lead or motivate the skilled person even to think about CPB microlithography or the distinctive problems associated with CPB microlithography.

Independent claim 1, as are all the subject claims, is directed to solving the following problem in CPB microlithography systems and methods (specification page 2, line 5 to page 3, line 7):

> For maximal "throughput" (*i.e.*, number of substrates that can be processed microlithographically per unit time), motions of reticles and substrates by the robotic manipulators usually occur while lithographic exposures are being performed simultaneously, at least to some degree. However, as a manipulator made of magnetic material is operated so as to cause movement of a part of the manipulator, the manipulator produces a moving "stray" magnetic field. If the moving part of the manipulator is located near an exposure location or near the trajectory of the charged particle beam, the moving magnetic field can cause a significant perturbation of the beam trajectory and/or exposure fidelity, which typically results in a distortion or other imaging fault of the pattern as actually formed on the resist-coated substrate.
>
> Exemplary stray magnetic fields generated in this manner include direct-current (DC) disturbances originating in the magnetic materials of motors built into the manipulators, direct-current/alternating-current (DC/AC) disturbances generated by electrical currents flowing to and from the manipulator, and DC/AC disturbances generated during actuation of the manipulator. Among these various disturbances, a particularly large disturbance is manifest in the magnetic-field fluctuations caused by movement of magnetic materials such as the arm of a robotic manipulator during actuation of the manipulator.

> Microlithographic exposures typically occur at or near the optical axis of the CPB microlithography system. In such systems (*e.g.*, electron-beam microlithography systems), a stray magnetic field (*e.g.*, as generated by a motor or other source in a robotic manipulator) has a magnitude that decreases in inverse proportion to the square of the distance between the source of the field and the optical axis. With robotic manipulators having a wide range of arm motion, the effects of stray magnetic fields conventionally are reduced by installing the "main unit" (containing motors and the like) of the manipulator at a maximal distance from the optical axis. However, if the arm itself is made of a magnetic material, then significant magnetic-field fluctuations affecting the beam trajectory tend to occur regardless of the distance between the main unit and the optical axis. These effects arise due to the rather large operational range of the arm and to the arm closely approaching the optical axis at least during some of its motions.

There is absolutely nothing in Pencis that discusses or hints at such a problem or how to go about solving it.

Rather, Pencis is directed to problems encountered with robot components when used in higher-temperature semiconductor-processing systems. ¶0003. More specifically,

> methodologies for increasing the accuracy of the robot generally do not compensate for thermal expansion and contraction experienced by the robot as heat is transferred to the robot from hot wafers and from hot surfaces within the process chambers. As evolving process technology has led to higher operating temperatures for many processes, transfer robots are increasingly exposed to high temperatures. Due to the increase[d] thermal exposure of transfer robots, the increase in robot linkage lengths and reach distances, it has become evident that robotic thermal expansion now substantially contributes to substrate misplacement.

¶0009. Solving the thermal problem as addressed by Pencis does not, and cannot, provide any hint as to how to solve a magnetic problem as addressed by the subject claims.

The CPB microlithography of independent claim 1 requires the following:

(a) a CPB optical system situated and configured to irradiate a charged particle beam onto an exposure-sensitive surface of a lithographic substrate so as to transfer and imprint a resolved pattern on the exposure-sensitive surface;

(b) a first robotic manipulator situated relative to the CPB optical system and configured for conveying an object relative to the CPB optical system; and

(c) the first robotic manipulator must comprise at least one moving member that moves, during actuation of the manipulator, relative to the CPB optical system, wherein the at

least one moving member is substantially non-magnetic and has a relative magnetic permeability of 1.0005 or less.

Pencis provides no teaching, suggestion, or hint regarding feature (a) (i.e., of microlithography performed using a charged particle beam); no teaching, suggestion, or hint regarding feature (b) (i.e., of a first robotic manipulator situated and configured as specifically recited in the claim); and no teaching, suggestion, or hint of feature (c) (i.e., of the particular type of moving member recited in the claim). Furthermore, Pencis provides no teaching, suggestion, or hint of any reason or manner in which feature (c) would be necessary or desirable.

Therefore, claim 1 and all claims depending therefrom are not obvious in any way from Pencis. The dependent claims are not obvious because they each include all the features recited in claim 1 as well as at least one respective additional feature providing a respective combination that is patentable in its own right.

Independent claim 26 is directed, in the context of a CPB microlithography method in which a charged particle beam is directed through a CPB optical system that produces a beam-controlling magnetic field so as to imprint a pattern on an exposure-sensitive surface of a lithographic substrate, to a method for conveying an object relative to the CPB optical system in a manner that does not cause any significant perturbation of the beam-controlling magnetic field. Pencis is absolutely silent on such methods, on beam-controlling magnetic fields, on any need to avoid perturbing such fields, and on any manner in which such perturbations can be avoided. The method of claim 26 requires that:

(a) the object be placed on a moving member of a robotic manipulator situated relative to the CPB optical system and configured for conveying an object relative to the CPB optical system;

(b) the moving member be substantially non-magnetic, having a relative magnetic permeability of 1.0005 or less; and

(c) the robotic manipulator be actuated so as to move the object relative to the CPB optical system.

Claim 26 is absolutely silent on feature (b) and on why such a feature would be important or desirable. Furthermore, claim 26 is absolutely silent on any combination of feature (b) with features (a) and/or (c) or with any other feature.

Therefore, claim 26 and all claims depending therefrom are not obvious in any way from Pencis. The dependent claims are not obvious because they each include all the features recited in claim 26 as well as at least one respective additional feature that provides a respective combination that is patentable in its own right.

The Office action admits that "Pencis et al. are silent on the moving member and object holding member being substantially non-magnetic, having a relative magnetic permeability of 1.0005 or less." But, the Office action contends that "Pencis et al. state the material comprising the end effector and/or the linkage is selected from a group comprising silicon carbide. Since the permeability of silicon carbide is 1.0001, the limitation of claims 1 and 26 are met." This contention is incorrect and misplaced. Claim 5 of Pencis recites that the end effector and/or linkage is selected from a group that includes aluminum/silicon carbide composites. A **composite** of silicon carbide necessarily includes at least one other material (in Pencis' case, aluminum), and such a composite of silicon carbide would not be expected to have the same magnetic permeability as silicon carbide itself. Furthermore, the mere mention of such a composite in claim 5 of Pencis provides no disclosure of what the actual permeability of the composite would be, or why any consideration or knowledge of magnetic permeability is important. Hence, this contention in the Office action lacks proper technical foundation and thus lacks substantive merit.

The Office action also contends (page 3), "Regarding claims 2, 12, 27 and 28, Pencis et al. do not discuss using the robot to move a reticle. As admitted in the specification (page 1, 2, lines 14-1), it is well known to use robots to move both reticles and wafers. It would be obvious . . . to modify the robot manipulator of Pencis et al. for use with reticles because typically, the entire motion sequence for wafers and reticles is completely automated." In reply to this contention, Applicant queries, "So what?" Applicant has stated in the specification (page 2, lines 5-8): "For maximal 'throughput' (*i.e.*, number of substrates that can be processed microlithographically per unit time), motions of reticles and substrates by the robotic manipulators usually occur while lithographic exposures are being performed simultaneously, at least to some degree." But, as discussed above, this conventional use of robots falls substantially short of the instantly claimed methods and systems that address the magnetic problems associated with CPB microlithography systems, as discussed above.

Therefore, claims 1-5, 9-12, 15, and 26-31 are properly allowable over Pencis.

Claims 6-8, 13-14, and 16-25 stand rejected for alleged obviousness from Wang in view of Pencis. This rejection is traversed.

First, this rejection is based on Wang "in view of Pencis et al. as applied to claim 1 above." This statement is not understood. Claim 1 previously was rejected (see above) for obviousness from Pencis alone. I.e., Pencis was the primary (and only) reference applied against claim 1. Now, in the instant rejection, claims 6-8, 13-14, and 16-18 (all of which depend from claim 1) stand rejected for obviousness from a combination of references of which Pencis is now the <u>secondary</u> reference, not the primary reference. Hence, this rejection fundamentally does not make sense. Explanation or clarification is requested.

Second, claims 6-8, 13-14, and 16-18 depend from claim 1 and are properly allowable over Pencis for all the reasons discussed above.

Third, Wang is directed to cluster tools that include multiple transfer chambers, wafer-transport robots, and process chambers. ¶0007. Wang provides additional load-lock chambers in communication with the robots. ¶¶0008-0009. Exemplary of the instantly rejected claims, independent claim 19 is directed specifically to charged-particle-beam (CPB) microlithography systems. Wang is absolutely silent regarding CPB microlithography systems and silent regarding any other systems that use or include a charged particle beam. Wang also provides no teaching, suggestion, or hint whatsoever that would lead or motivate the skilled person even to think about CPB microlithography or the distinctive problems associated with CPB microlithography. As discussed above, Pencis glaringly fails to fulfill this deficiency of Wang.

Fourth, it is pointed out that a wide variety of wafer-processing methods are known, of which microlithography is a small (but highly specialized) subset. Wang utterly fails even to mention microlithography or that the robotic systems discussed in Wang are applicable in a practical sense to microlithography systems. Rather, the Wang system is directed to clustered processes such as physical vapor deposition that require a large number of individual process chambers to achieve the desired processing result. ¶0036. Hence, it is not immediately apparent from Wang how, contrary to the contentions in the Office action and especially in the context of the entire Wang apparatus, items 118, 178, 134, 130, and 146 are "configured to handle reticles" or items 104, 176, 132, 148, and 124 are "configured to handle substrates."

Fifth, the Office action also contends, with respect to claim 19 and its dependents, "It would be obvious . . . to adapt the apparatus of Wang et al. to handle reticles for

microlithographic tools requiring changes of reticles because Wang et al. teach that wafer processing throughput is increased by increasing the number of load locks that are accessible to the buffer (load) chambers." It is not understood from this contention how or why increasing the number of load-locks would lead to increased lithographic throughput. The number of load-locks is not the pivotal factor governing throughput in lithography; rather, other factors (exposure dose, exposure time per exposure shot, number of exposures required per die, number of dies per wafer, acceleration and deceleration of stages, and the like) are key. Merely increasing the number of load-locks, without more information than provided in Wang, leaves the skilled person with no conception of how such action would or could provide the desired greater lithographic throughput. As discussed above, Pencis does not fill in this information gap.

Also, increasing the number of load-locks in Wang provides no information whatsoever to the skilled person of why or how to solve the magnetic problem addressed by the subject claims. Furthermore, increasing the number of load-locks provides no teaching or suggestion whatsoever of, for example, any of the following features, either alone or in combination, recited in claim 19: (a) providing an illumination-optical system situated inside a first vacuum process chamber, (b) providing a projection-optical system situated inside a second vacuum process chamber, (c) a first robotic manipulator comprising moving members that are substantially non-magnetic and having a magnetic permeability of 1.0005 or less, and (d) a second robotic manipulator comprising moving members that are substantially non-magnetic and having a magnetic permeability of 1.0005 or less. As discussed above, Pencis does not fulfill these deficiencies of Wang.

Sixth, the Office action discusses the first robotic manipulator in Wang as having a first shaft. The Office action states, "The fact that Wang et al. fail to disclose a specific property of the material from which the shaft is made, like non-magnetic, indicates that it is inherent in the description of the shaft [and] that it can be made of any suitable machinable material - this could include non-magnetic materials." This contention is groundless and incorrect. A feature that is "inherent" <u>must</u> exist. There is absolutely nothing in Wang indicating that the first shaft, or any other component of the Wang apparatus, must be non-magnetic. There is also nothing in Wang indicating or suggesting that any component could be non-magnetic and still work for its respective intended purpose. There is also nothing in Wang indicating or suggesting any need to make the shaft non-magnetic or of any benefit that could be realized from a non-magnetic shaft.

Furthermore, the Office action stating "this could include non-magnetic materials" is simply speculation, and the examiner's speculation is not a proper foundation for an obviousness rejection.

Therefore, claims 6-8, 13-14, and 16-25 are properly allowable over any combination of Wang and Pencis.

Applicant has a right to an interview at this stage of prosecution. If any issues remain unresolved after consideration of the contents of this paper, the examiner is requested to contact the undersigned to schedule a telephonic interview. Any inaction by the examiner to make such contact, followed by issuance of a final action, will be regarded as an acquiescence by the examiner to grant an interview as a matter of right after the final action.

Respectfully submitted,

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